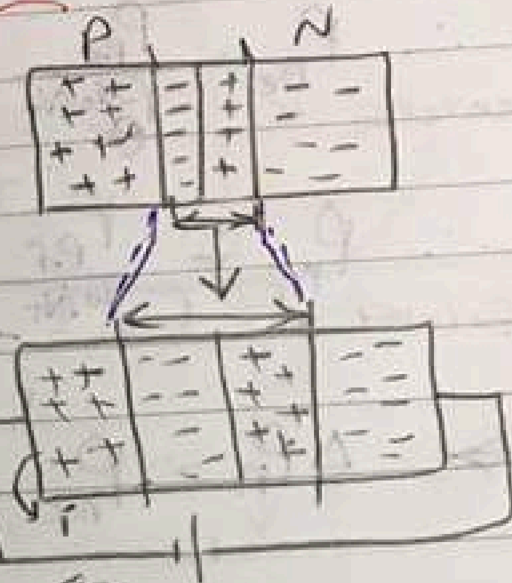
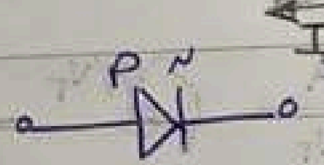
* PN junction under Reverse Bias :-

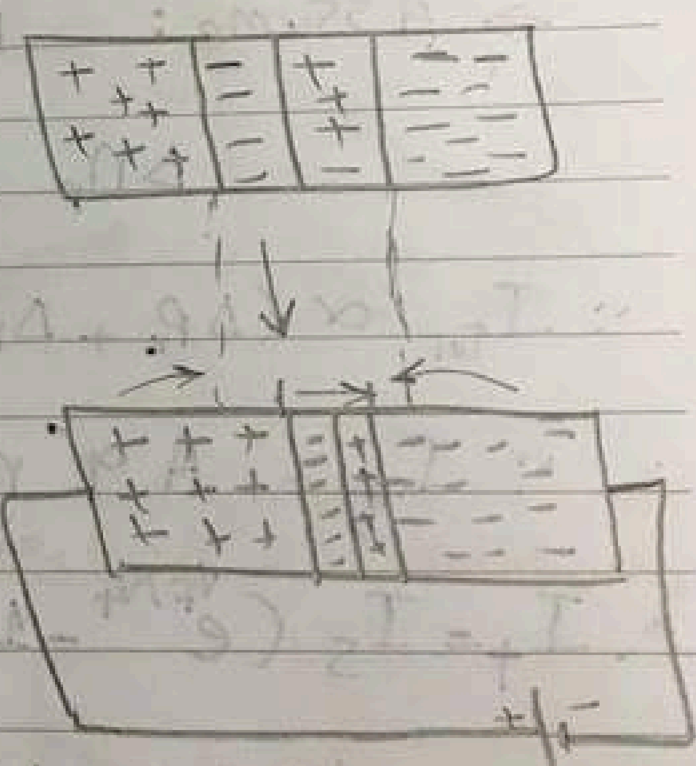


في حالة ال Reverse بتجاذب موجب الدايود مع سالب البطارية
ويتجاذب سالب الدايود مع موجب البطارية
هتزداد مساحة ال Deplation Region
فتبقى وكأنها open c "دائرة مفتوحة"
تعدم مرور التيار و يكاد ينعدم.

$$\Rightarrow C_j = \frac{C_0}{\sqrt{1+\frac{V_R}{V_0}}}$$



* Forward Bias :-



في حالة ال Forward
يحدث تنافر بين P-type و الطرف + للبطارية
" " " n-type " " - السالب "
فتنكمش مساحة ال Deplation Region
فتبقى وكأنها S.C "سلك عادي".

$$V_0 = \frac{kT}{q} \ln \frac{P_p}{P_n} \Rightarrow \text{at (P-side)}.$$

$$\Rightarrow \because \frac{kT}{q} = V_T \rightarrow \text{thermal}$$

$$\therefore V_0 = V_T \ln \frac{P_p}{P_n} \qquad \therefore \frac{V_0}{V_T} = \ln \frac{P_p}{P_n}$$

$$\therefore e^{V_o/V_T} = \frac{P_p}{P_n} \Rightarrow \therefore P_n = \frac{P_p}{e^{V_o/V_T}}$$ at equilibrium في حالة التعادل

$$\therefore P_{n_e} = \frac{P_{Pe}}{e^{V_o/V_T}} \rightarrow (1)$$ reverse

$$\therefore P_{nf} = \frac{P_{P.f}}{(e^{V_o/V_T} - V_f)} \rightarrow (2)$$ forward

$$\Rightarrow \Delta P_n = P_{n.f} - P_{ne} = \left[\frac{P_{P.f}}{(e^{V_o/V_T} - V_f)} - \frac{P_{Pe}}{e^{V_o/V_T}}\right]$$

$$\therefore \Delta P_n = \frac{N_A}{e^{V_o/V_T}} (e^{V_f/V_T} - 1) \longrightarrow *$$

$\Rightarrow$ Assume: $P_{Pe} = P_{Pf} = N_A$

$$\therefore \Delta n_p = \frac{N_D}{e^{V_o/V_T}} (e^{V_f/V_T} - 1) \rightarrow **$$

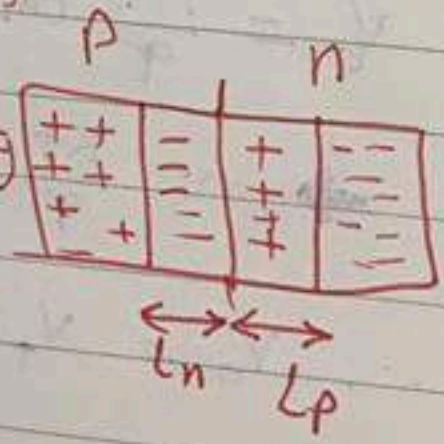
$$\because I_{Tot} \propto (\Delta P_n + \Delta n_p) \quad \therefore I \propto \frac{N_A}{e^{V_o/V_T}} (e^{V_f/V_T} - 1) + \frac{N_D}{e^{V_o/V_T}} (e^{V_f/V_T} - 1)$$

$$\therefore \because I_S = A q \overset{\downarrow}{n_i^2}_{=n.p} \left[\frac{D_n}{N_A L_n} + \frac{D_p}{N_D L_p}\right]$$ (N_A: P-type, N_D: n-type)

$$\therefore I_f = I_S (e^{V_f/V_T} - 1)$$

→ L_p is the diffusion of P-type in n-type

→ L_n " " " of n-type in P-type



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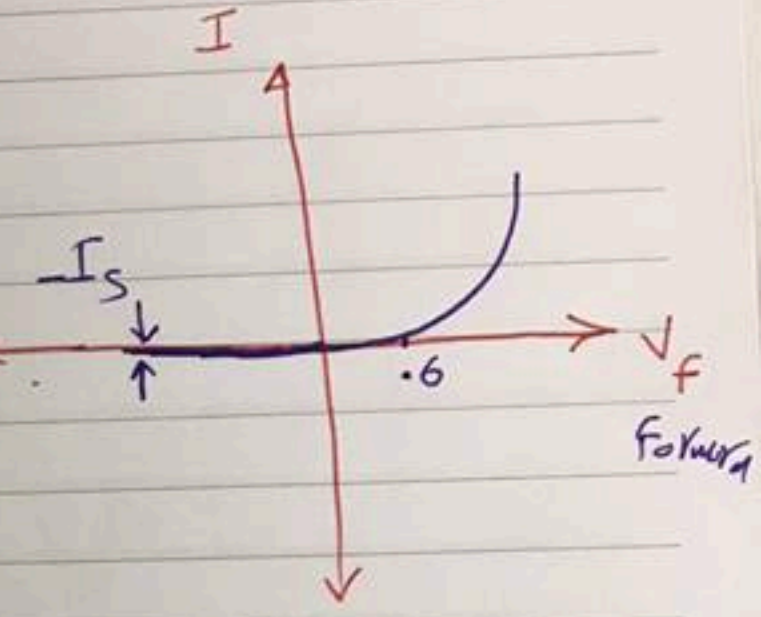
* $I_T = I_S (e^{V_F/V_T} - 1)$

→ at $V_F = 0 \Rightarrow I = 0$

→ at $V_F = .6 \Rightarrow I \simeq 0$



V_f

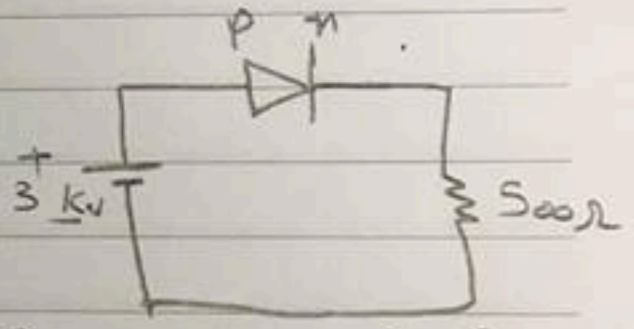
$= .6$ $= 0$

Constant Model. ideal Model

ex:-

∵ the Connect with P type

∴ P-N function under Forward bias

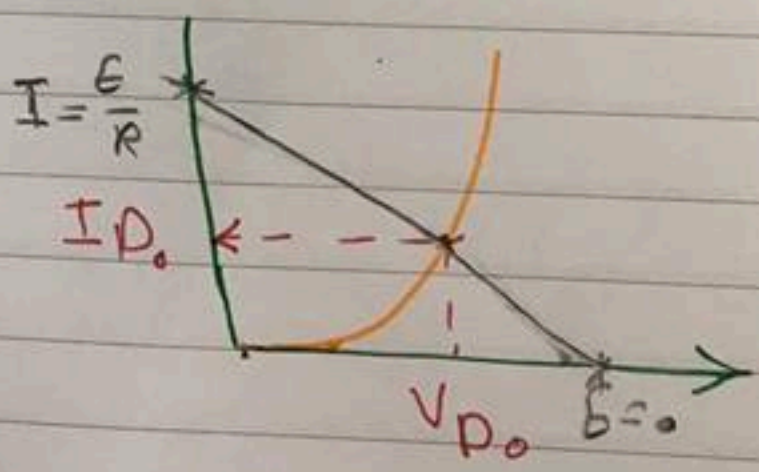


$\Rightarrow \mathcal{E} = V_p + I_p * R$

at $V_D = 0$ $\therefore \mathcal{E} = I_p * R$ $\therefore I_p = \frac{3*10^3}{500}$

$\Rightarrow$ at $I_D = 0$ $\therefore \mathcal{E} = V_D$

$\Rightarrow \frac{V_{D_0}}{I_{D_0}} = R_{D_0}$ "static Resistance" ثابت المقاومة



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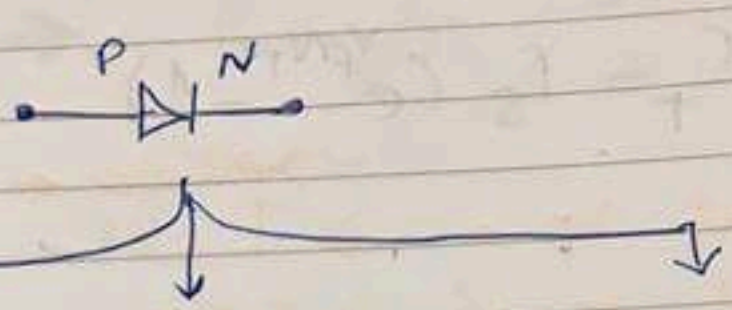
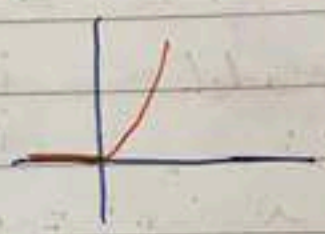


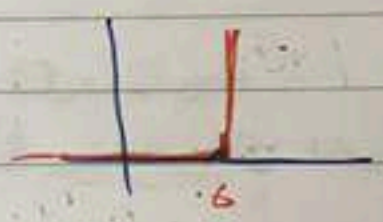
1. Ideal
2. Constant Voltage
3. exponential

1 $\Rightarrow I_D = I_S (e^{V_{D}/kT} - 1)$

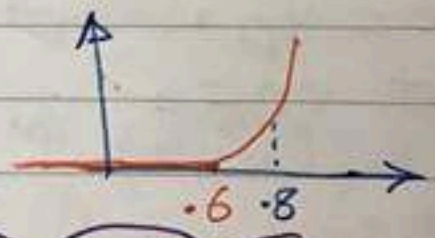
$I_D = I_S (\exp \frac{V_D}{kT} - 1)$



2 $I_D = I_S (e^{V_{D}/kT} - 1)$ $V_D = .6$



3 exponential

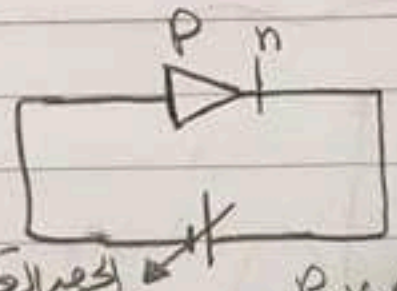


$$I_S = A q n_i^2 \left(\frac{D_n}{N_A L_n} + \frac{D_p}{N_D L_p} \right)$$

I_S تعتمد على هيه

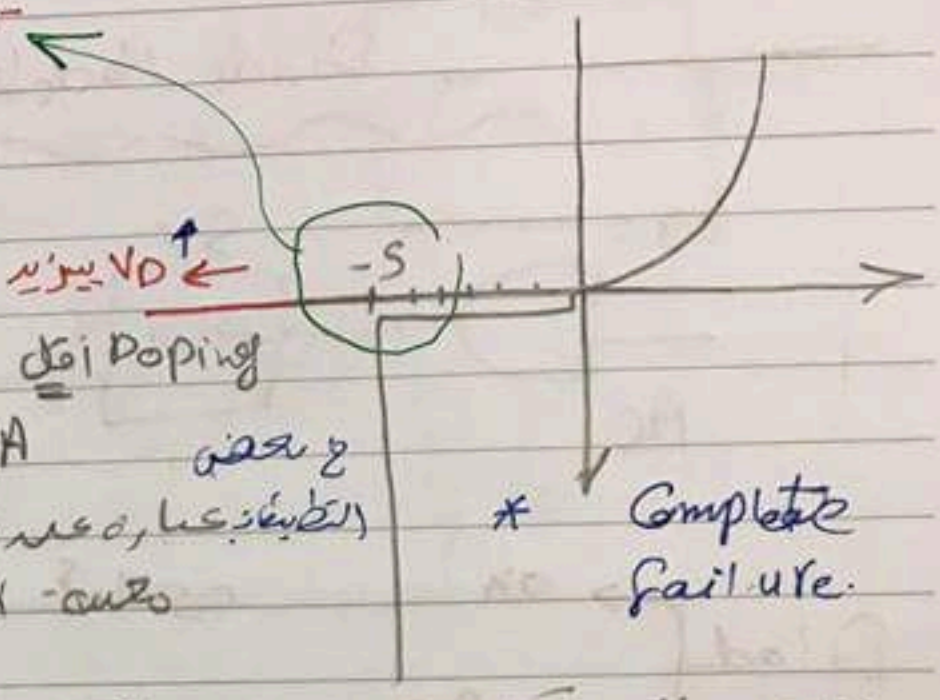
نوع من انواع الدايود

Zener Breakdown :-



الجهد العكسي يزيد

Reverse B.A



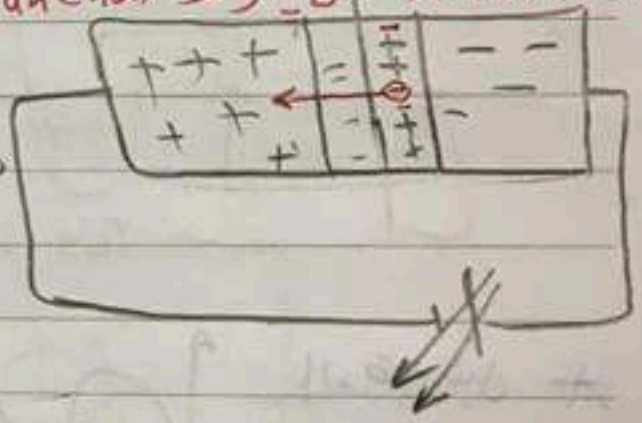
Doping اقل

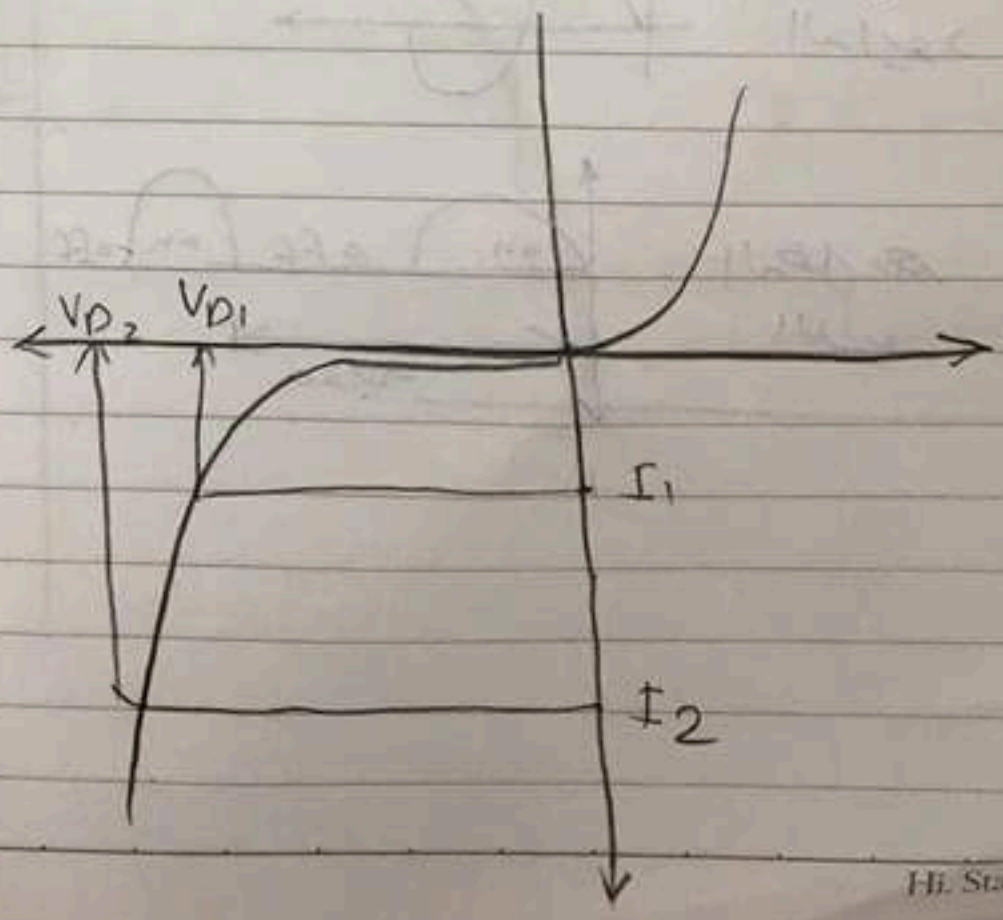
في بعض التطبيقات عبارة عن دايود الـ Doping يتاكه بنسبة معينة من الشوائب.. تثبيت الفولت وزيادة شدة التيار

عند زيادة الجهد العكسي يزيد جداً وكسب الالكترونات - طاقة حركة كبيرة فتتحاذب مع فجوات P-type .. فيحدث انهيار للـ Junction . وسمي هذا Junction الانهيار لل Breakdown

AVALANCH BD

وهذا يحدث عند Doping اقل وفرق جهد عالي.





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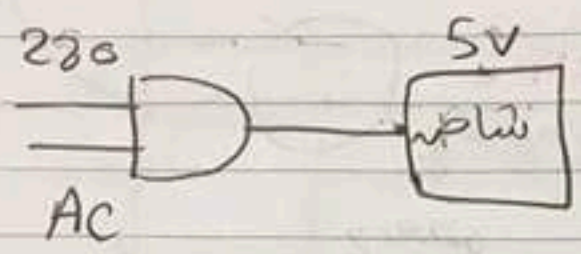
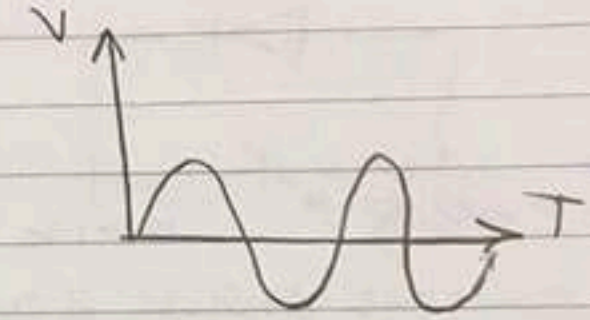
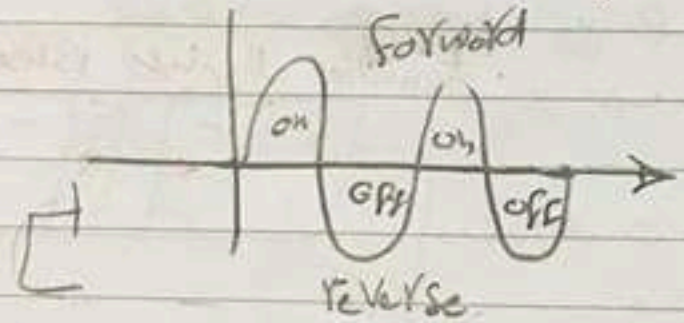
CH 2 :-

Diode Models and Application

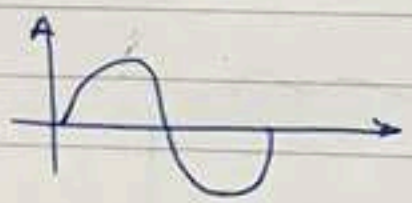




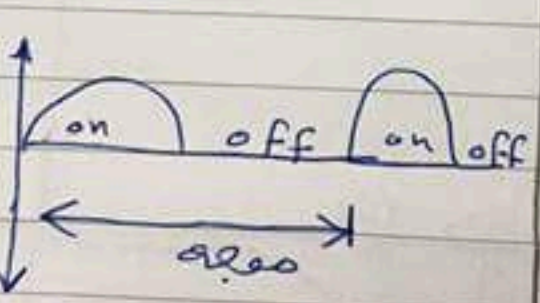
Diod as switch → on أمامي
→ off عكسي



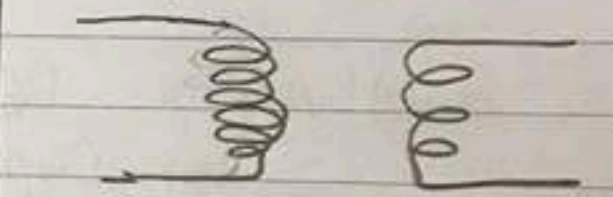
* الدخل قبل الدايود



* الدخل بعد الدايود



الفولت
* Step down transformer



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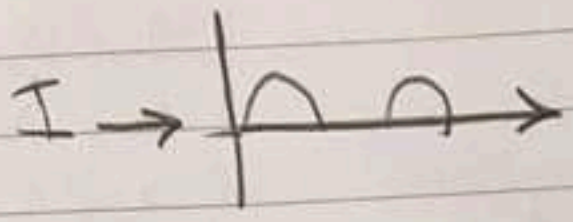
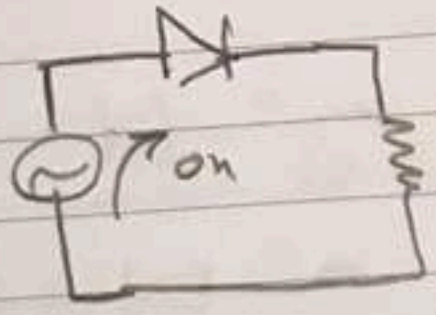
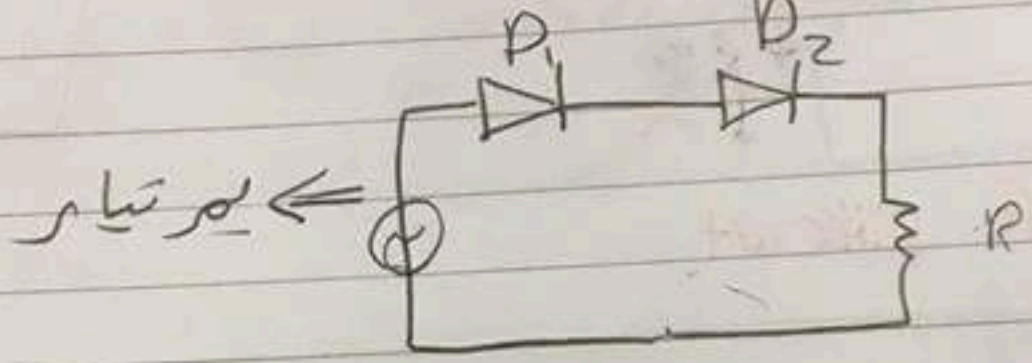
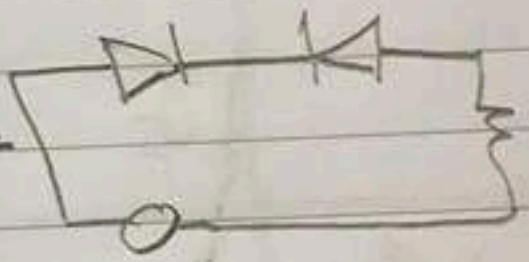


تيار AC

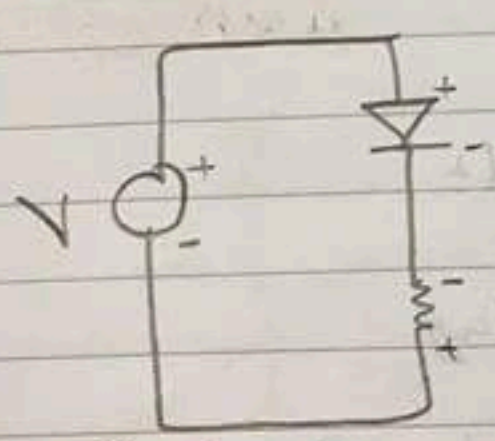




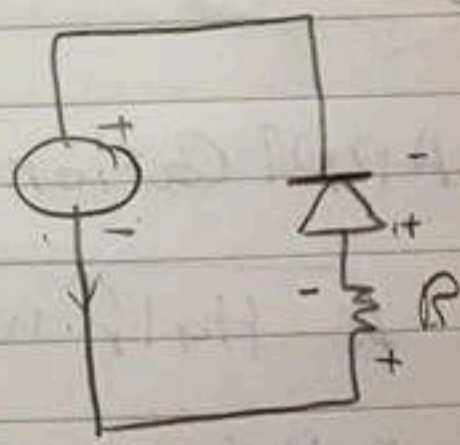
يمر تيار ⇐



لا يمر تيار ⇐

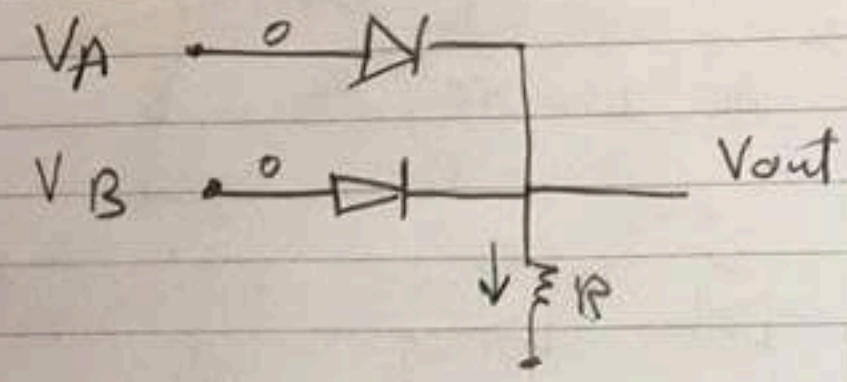


Forward



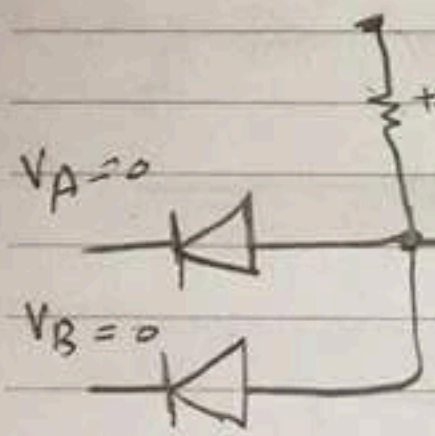
Reverse

الاتجاه العكسي يمنع تيار



VA	VB	Vout
0	0	0
0	1	1
1	0	1
1	1	1

OR Circuit



VA	VB	Vout
0	0	0
0	1	0
1	0	0
1	1	1

AND circuit

Application of Diod:

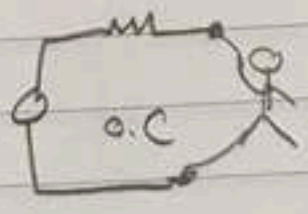
1. ★ Half wave Rectifing

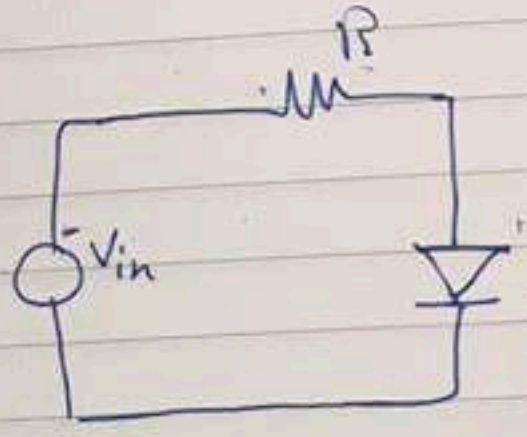
* Diode ⇒ OR, AND

Resistor Diode Circuits

at $V_{in} < 0$ Diode forward
open circuit

$V_{in} = V_{out}$

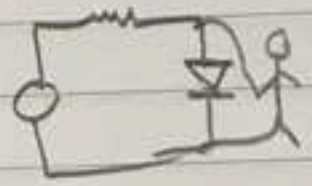




at $V_{in} > 0$

ideal ① $V_D = 0$ ∴

② $V_D = .6$



① ⇒ Diode forward on
$\therefore V_D = 0 = V_o$

② $V_D = .6$